USDA United States Department of Agriculture

Natural Resources Conservation Service

1996

Annual Report

Little Bluestem
Schizachyrium scoparium (Michx.) Nash

Switchgrass
Panicum virgatum L.

Eastern Gamagrass
Tripsacum dactyloides (L.) L.

Cape May Plant Materials Center

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INTRODUCTION

The mission of the Cape May Plant Materials Center (PMC) is to develop vegetative solutions to conservation problems utilizing primarily native plants. The Cape May PMC is operated and administered by the U.S. Department of Agriculture, Natural Resources Conservation Service (formerly the Soil Conservation Service). The 92 acre Cape May PMC was established in 1965 in response to coastal erosion in the Mid-Atlantic. The service area of this PMC is served by the Plant Materials Specialists stationed in North Carolina, New Jersey, and New York.

The Cape May PMC has been given the challenge of developing and promoting new and improved plants, as well as improving cultural methods and management techniques for conserving our natural resources. The primary objectives of the Cape May PMC include:

I. Enhance and Protect Water Quality
II. Protect and Restore Coastal Resources
III. Reduce Water and Wind Erosion on Cropland
IV. Contribute to the Production of Plant Material Needs for the Northeast Service Area

To date, the Cape May PMC has released 11 plant material cultivars to the commercial market; six native to the Mid-Atlantic Region, two naturalized, and only three from introduced sources. The cultivars are:

	ORIGIN	RELEASE YEAR
Lonicera maackii 'Rem-Red' amur honeysuckle	Introduced	'70
Ammophila breviligulata 'Cape' American beachgrass	Native	'72
Lespedeza thunbergii 'Va-70' shrub lespedeza	Introduced	'79
Panicum amarum var. *amarulum* 'Atlantic' coastal panicgrass	Native	'81
Carex kobomugi 'Sea Isle' Japanese sedge	Naturalized	'83
Juniperus conferta 'Emerald Sea' shore juniper	Introduced	'86
Spartina patens 'Avalon' saltmeadow cordgrass	Native	'86
Spartina alterniflora 'Bayshore' smooth cordgrass	Native	'92
Myrica pensylvanica 'Wildwood' bayberry	Native	'93
Prunus maritima 'Ocean View' beachplum	Native	'93
Rosa rugosa 'Sandy' rugosa rose	Naturalized	'93

LOCATION & SITE DESCRIPTION

The Cape May PMC is located in Cape May County which is New Jersey's southern most county. The center is approximately 24 miles south of Atlantic City sandwiched between the Garden State Parkway and US Route 9. Approximately, 500 feet east of the PMC starts the tidal marsh which surrounds Great Sound, a body of water lying between the Cape May PMC and the Borough of Avalon.

The climate at the Cape May PMC varies from semi-humid to semi-maritime conditions with average precipitation at 40 inches. During periods when precipitation is below normal, a deep (5.5) acre pond, on the PMC, is utilized for irrigation. The average annual maximum and minimum temperatures at the Cape May PMC are 63°F and 44°F, respectively. The Cape May PMC lies in USDA Plant Hardiness Zone 7b, with approximately a 193 day growing season.

The soils on the Cape May PMC are the product of wind mixed marine soils and glacial outwash which has weathered since the Pleistocene Age. The Downer, Sassafras, Fort Mott, and Woodstown soil series are all found on this property with the Downer and Sassafras predominating the acreage. The soils on the Cape May PMC can be generally described as nearly level, well drained, with low to moderate naturally fertile soils. These soils encountered at the Cape May PMC are usually strongly acid in their natural state. The surface feature of these soils ranges from sand to loamy sand. Most fruits and vegetables can be grown on these soils but irrigation is a necessity to insure success. The elevation of the Cape May PMC ranges from 18 to 21 feet above sea level, with slope not exceeding one percent. The four soil series listed above have Soil Capability Classes ranging from I for the Sassafras series to III for the Fort Mott series. The site index of these soils ranges from 66 to 85 for the native pines and oaks.

Agricultural operations are predominantly cash row crops, orchards, truck crops, specialty crops, and poultry. A trend towards cash crop operations has reduced the use of hay and pasture plants in the cropping systems. Clean cultivation on large tracts of land has increased soil erosion and water quality degradation.

Non-agricultural activities play a dramatic role in the use of conservation plants. A large portion of this area is covered by hardwood and pine forests. Extensive areas of tidal marsh are vital to the seafood and wildlife resources essential to the area's economy. Also, sand and gravel mining, and industrial and residential development, create sizable disturbances which utilize plants for stabilization.

Fifteen percent of the nation's population lives within commuting distance of the area served by the center. In most areas, an extensive summer resort industry has expanded into a year-round enterprise, creating a demand for high use recreational facilities.

The area served by the Cape May PMC includes the Mid-Atlantic coastal plain and the piedmont area, extending from Cape Cod, Massachusetts to Sunset Beach, North Carolina (See Service Area Map). The Major Land Resource Areas within the service area are listed below under the nine states each is associated with.

Massachusetts
- 143 - Northeastern Mountains
- 144A - New England and Eastern New York Upland, Southern Part
- 144B - New England and Eastern New York Upland, Northern Part
- 145 - Connecticut Valley
- 149B - Long Island, Cape Cod Coastal Lowland

Connecticut
- 144A - New England and Eastern New York Upland, Southern Part
- 145 - Connecticut Valley

Rhode Island
- 144A - New England and Eastern New York Upland, Southern Part

New York
- 149B - Long Island - Cape Cod Coastal Lowland

New Jersey
- 144A - New England and Eastern New York Upland, Southern Part
- 148 - Northern Piedmont
- 149A - Northern Costal Plain

Maryland
- 148 - Northern Piedmont
- 149A - Northern Costal Plain
- 153B - Tidewater Area
- 153C - Mid-Atlantic Coastal Plain

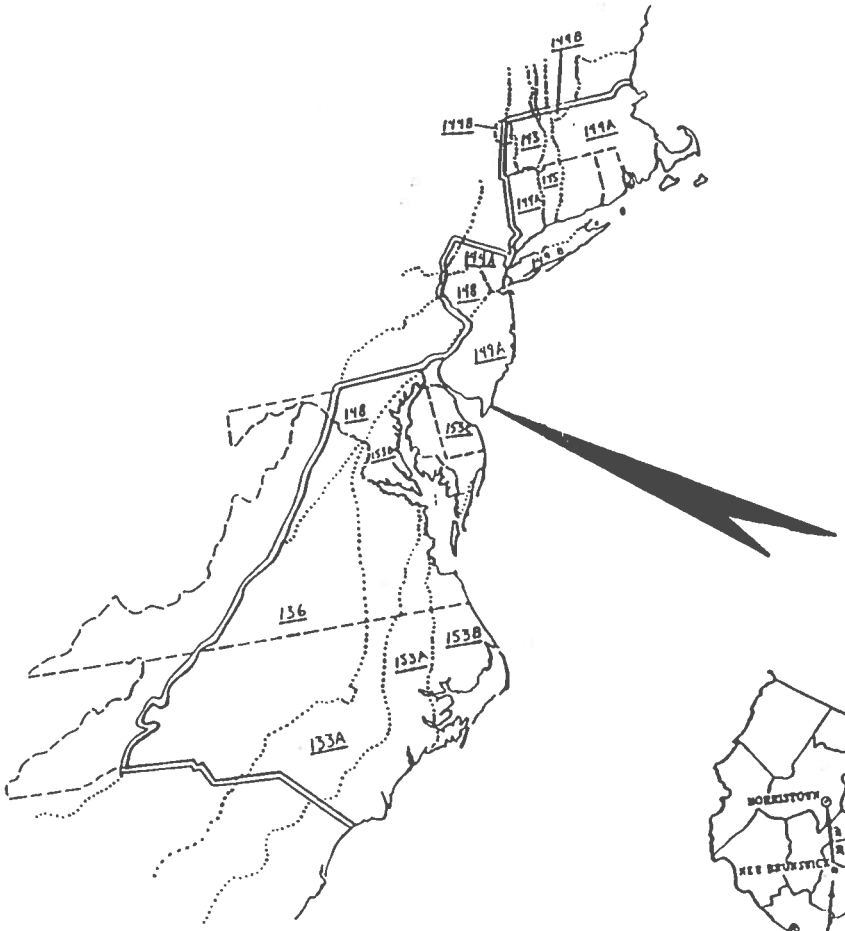
Delaware
- 148 - Northern Piedmont
- 149A - Northern Costal Plain
- 153C - Mid-Atlantic Coastal Plain

Virginia
- 133A - Southern Coastal Plain
- 136 - Southern Piedmont
- 153A - Atlantic Coast Flatwoods
- 153B - Tidewater Area
- 153C - Mid-Atlantic Coastal Plain

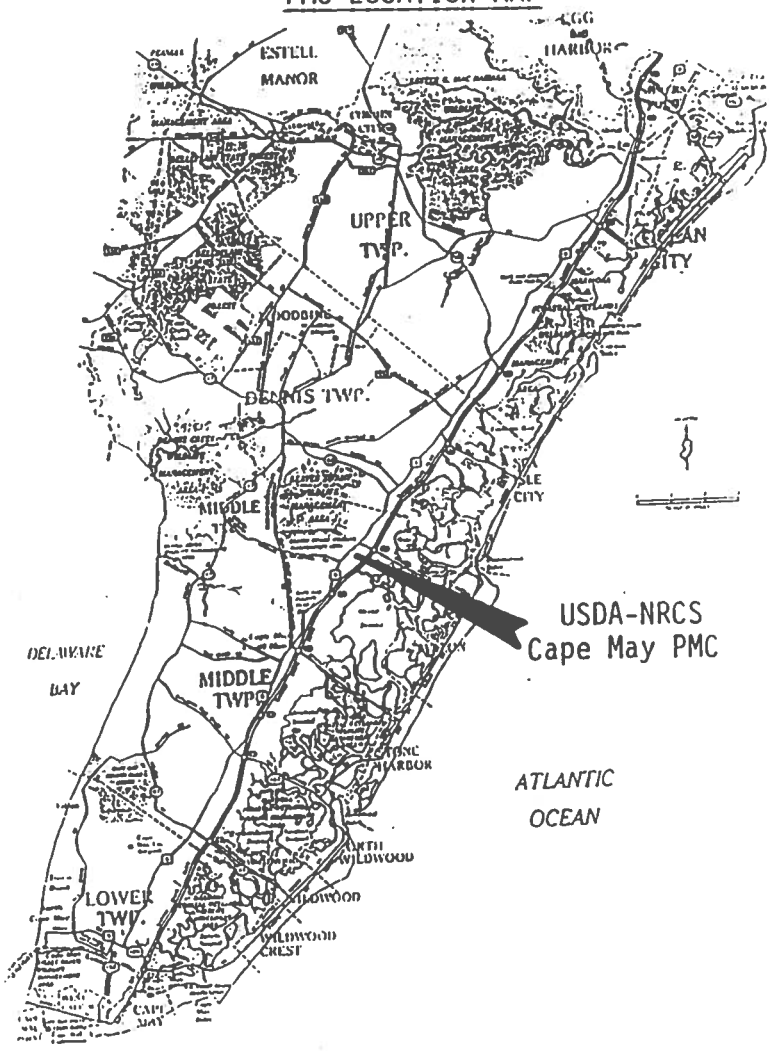
North Carolina
- 133A - Southern Coastal Plain
- 136 - Southern Piedmont
- 153A - Atlantic Coast Flatwoods
- 153B - Tidewater Area

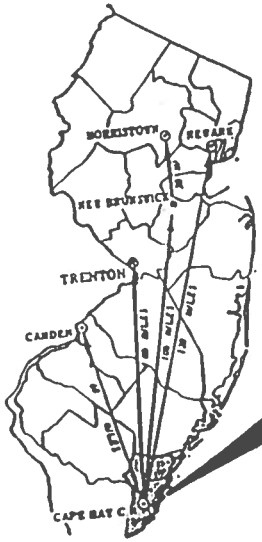
CAPE MAY PLANT MATERIALS CENTER
USDA - NATURAL RESOURCES CONSERVATION SERVICE
CAPE MAY COURT HOUSE, NJ

SERVICE AREA MAP



PMC LOCATION MAP

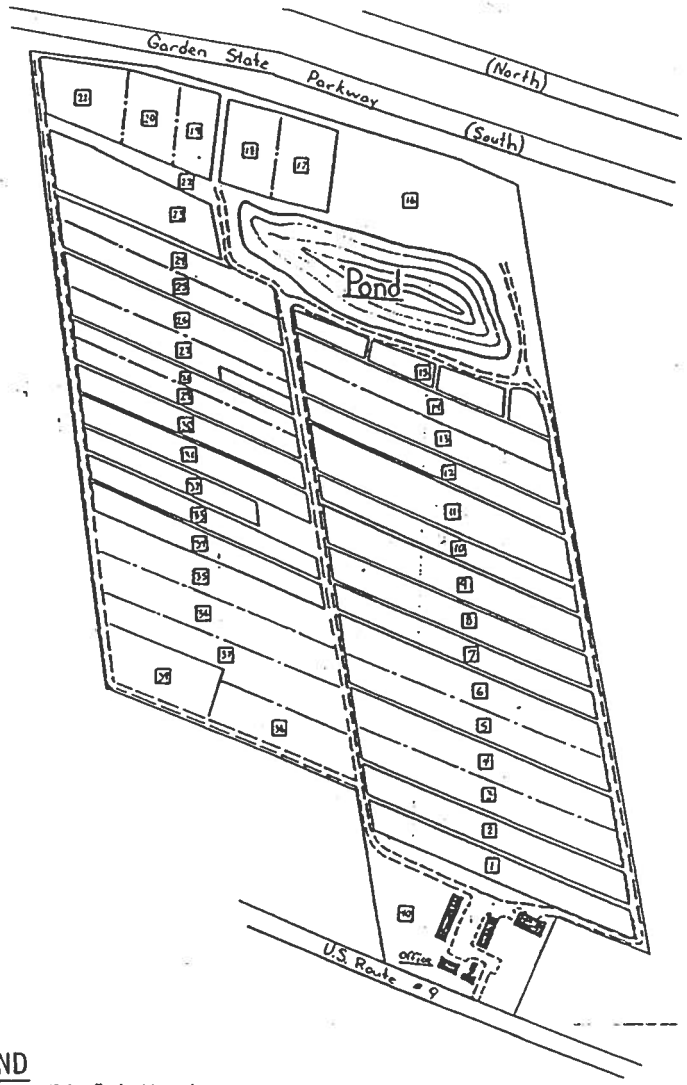




LEGEND

——— Service Area Boundary
Major Land Resource Area Number
..... MLRA Boundary Line
------ State Boundary Line

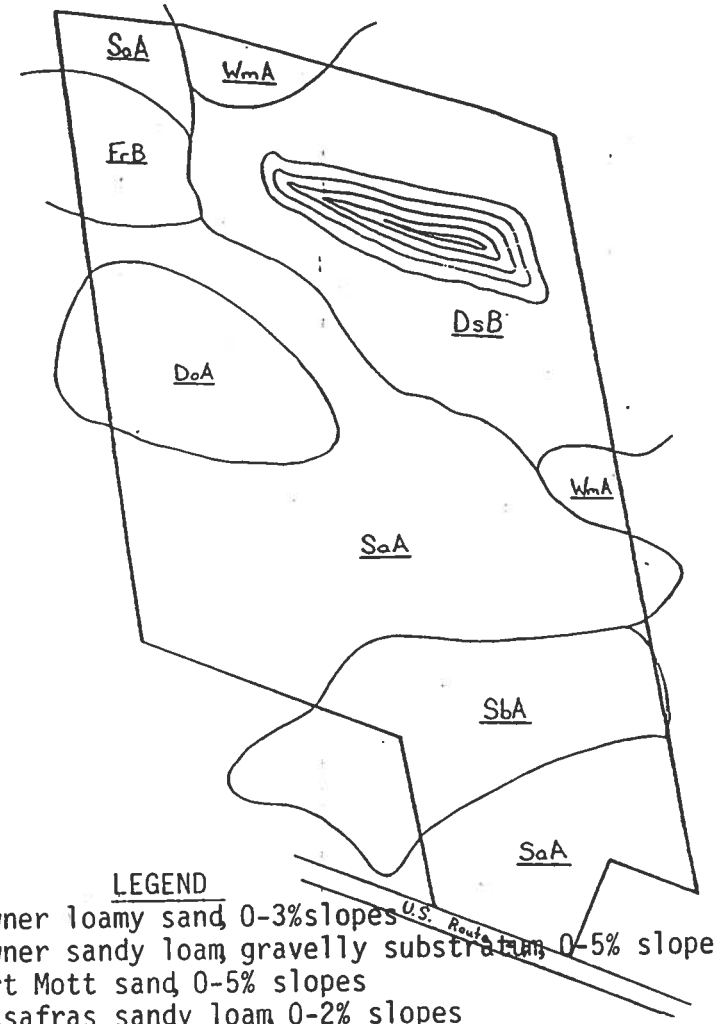
PROPERTY & FIELD MAP



LEGEND

- Field Number
- Access Lane
- PMC Buildings
- Field Divisions
- Pond

SOILS DELINEATIONS



LEGEND

DoA Downer loamy sand, 0-3% slopes
DsB Downer sandy loam, gravelly substratum, 0-5% slopes
FrB Fort Mott sand, 0-5% slopes
SaA Sassafras sandy loam, 0-2% slopes
SbA Sassafras sandy loam, water table, 0-2% slopes
WmA Woodstown sandy loam, 0-2% slopes

SERVICE AREA

DESCRIPTION OF SERVICE AREA

Soils, topography, climate, and land use combine to produce distinct plant resource areas. The soil-forming materials of the Mid-Atlantic Coastal Plain include glacial outwash and underlying beds of sand, gravel, silt, and clay. Problems in this area include active migrating sand dunes that exist along the coast, wind erosion which occurs on sandy cultivated fields, water erosion on sloping cropland, and stream bank erosion which threatens the tidal estuaries. The soils vary from excessively well drained to poorly drained and swampy. There are large tracts of tidal marsh bordering bays, river inlets and the ocean.

The topographic relief ranges from large areas of level or slightly sloping land to less extensive sections of moderately rolling ridges. The relatively level coastal plain rises from sea level to elevations of more than 600 feet in the piedmont. Level to gently undulating topography characterizes the coastal plain, while gentle slopes and steep ridges are predominant in the piedmont.

The climate is tempered by the Atlantic Ocean. There are wide fluctuations in annual precipitation, and to a lesser extent, in temperature. Drought years do occur and tropical hurricane storms are common. Mean annual precipitation in the area ranges from 38 to 46 inches. The frost-free season varies from 170 to 250 days, with the mean being 192 days. Length of growing season is affected by latitude and elevation. The Cape May PMC Service Area includes USDA Plant Hardiness Zones 5-8.

WEATHER RECORDS AT CAPE MAY PLANT MATERIALS CENTER FOR 1996

	Air Temperature °F					4" Soil Temperature °F				
	Maximum			Minimum		Maximum			Minimum	
Month	Ext.	Av.	Deviation	Av.	Ext.	Ext.	Av.	Deviation	Av.	Ext.
JAN	58	41	0	+1	24	10	45	39	0	−4	32	31
FEB	64	42	0	+1	26	01	48	39	+1	+1	37	32
MAR	65	47	−3	−5	29	14	51	45	−1	−2	39	33
APR	79	60	0	+2	43	32	62	51	−4	−5	45	37
MAY	92	67	−2	+1	51	36	72	62	−3	−3	56	53
JUNE	88	79	0	+2	63	47	77	73	−3	−2	68	56
JULY	90	81	−3	0	66	57	78	76	−5	−6	70	68
AUG	89	81	−2	0	64	60	77	72	−8	−5	70	67
SEPT	88	77	−1	+3	61	46	76	70	−4	−3	66	60
OCT	78	66	0	+3	48	37	68	61	−3	−3	56	54
NOV	69	50	−4	−6	33	19	58	49	−3	−4	44	40
DEC	59	44	−2	+3	32	16	48	44	0	−3	38	34
1996	92	61			45	01	78	57			52	31
Normal*		63			45			60			55	

*Normal based on:
31 yr. Air Temperature; 27 yr. Soil Temperature
Frost Free Days 207–April 10 to November 4, 1996. Normal 195 days.

	Precipitation			
Month	Total Inches	Deviation	Greatest Daily	No. Days
JAN	4.07	+0.62	.92	14
FEB	1.09	−1.85	.28	10
MAR	3.30	−0.38	.93	9
APR	4.35	+0.89	1.53	13
MAY	5.13	+1.20	.84	17
JUNE	4.04	+0.18	1.55	12
JULY	6.42	+3.42	2.14	14
AUG	4.55	+0.47	2.73	9
SEPT	8.21	+5.17	2.68	9
OCT	5.44	+2.08	2.39	8
NOV	1.29	−2.07	.45	7
DEC	6.26	+2.61	1.38	17
1995	54.15	+12.34	2.73	139
NORMAL*	42			

*Normal based on:
31 year Precipitation. Snowfall fell between Jan. 9 – March 8 for a total of 27.1".

I. ENHANCE AND PROTECT WATER QUALITY

1. PROPAGATION TECHNIQUES FOR PERENNIAL WETLAND PLANT SPECIES OF THE MID-ATLANTIC UNITED STATES

a) Advances in Wetland Seeding
b) Bear Creek Status Report
c) Inter-species Competition

ADVANCES IN WETLAND SEEDING

Introduction

With the elevated involvement of NRCS in the enhancement, restoration, and creation of agriculturally associated wetlands, there exists a great need for effective plant production and establishment technologies. As many of you may already be aware, wetland ecosystems are effective at retaining storm water which implies a reduction in the threat of floods, extracting nutrients and other pollutants from surface water runoff, filtering suspended particles from runoff, as well as provide diverse wildlife habitats. The specifications and technical notes for these structures have been developed, but the plant establishment provisions are often vague or incomplete.

It became evident to the Cape May Plant Materials Center staff and its advisory committees that as NRCS takes its leading role in the agricultural wetland arena, more wetland plant establishment information will need to be available. As with vegetating most natural ecosystems, seed establishment is genetically desirable, time effective, and economical. Documentation on the actual seedling procedures is hard to find or nonexistent for most native species. At the Cape May PMC, staff members have been evaluating and documenting procedures for successfully establishing thirty-six species from twenty-nine genera.

Methods and Materials

In recent studies at the Cape May PMC, freshwater emergent species were subjected to four different seed stratification procedures; these procedures included dry control, distilled water, moist peat moss, and moist sand storage medias. All seed treatments were then placed in refrigeration (35^-40^ F) for three months. Stratified seed was removed from storage and placed on a saturated 2:1 mix of sand and peat moss. Each treatment was replicated three times, using one hundred seeds in each, and was carried out in greenhouses. The species evaluated with this procedure included:

Alisma subcordatum	Aronia arbutifolia	Bidens discoides
Calamograstis stricta	Carex crinita	Carex lurida
Cladium mariscoides	Diospyos virginiana	Eleocharis obtusa
Echinochloa frumentacea	Eriophorum virginicum	Glyseria obtusa
Hibiscus moscheutos	Ilex verticillata	Iris versicolor
Juncus effusus	Nyssa sylvatica	Panicum virgatum
Peltandra virginica	Polygonum hydropiperoides	Pontedaria cordata
Rhexia virginica	Sagittaria latifolia	Scirpus acutus
Scirpus cyperinus	Scirpus maritimus	Scirpus pungens
Scirpus tabernaemontani	Sparganium americanum	Sp. eurycarpum
Spartina cynosuroides	Triadenum virginicum	Typha angustifolia
Typha latifolia	Xyris fimbriata	Zizania aquatica

Results

The results recorded for each species and storage treatment has been consistent from year to year, but varied greatly between species. Initial emergence varied between species from one to sixteen days, for the most effective treatments of each specie. The treatments which provided the best emergence were not always the treatment which induced the best plant performance. In the next phase of wetland seeding studies (1997), the PMC staff will attempt to apply these greenhouse procedures in field locations. For individual seed establishment results see attached table.

WETLAND SEED STRATIFICATION AND STORAGE STUDY
(1994-1996 RESULTS)

Species	Storage Type				1st day
	Dry	Water	Wet Peat	Wet Sand	Germ
Alisma subcordata		X	X1	X	6
Aronia arbutifolia	X2				N/A
Bidens discoides			X1	X	2
Calamograstis stricta		X	X1		6
Carex crinita		X1	X1	X	6
lurida		X1	X1	X	6
Cladium mariscoides					N/A
Diospyos virginiana		X1	X1	X1	14
Echinochloa frumentacea	X				6
Eleocharis obtusa	X1	X	X		16
Eriophorum virginicum		X	X	X1	14
Glyseria obtusa		X1	X1	X	6
Hibiscus moscheutos	X	X	X1	X1	7
Ilex verticillata	X2				N/A
Iris versicolor			X1		13
Juncus effusus	X	X	X1	X	4
Nyssa sylvatica	X2				N/A
Panicum virgatum	X	X	X	X1	16
Peltandra virginica	X		X1		7
Polygonum Hydropiperoides		X	X1	X	8
Pontedaria cordata	X	X	X	X1	6
Rhexia virginica			X1	X	8
Sagittaria latifolia	X1	X	X1	X1	2
Scirpus acutus	X	X	X1	X	8
cyperinus	X	X	X1	X	4
maritimus	X	X1	X	X1	7
pungens	X	X1	X1	X	8
tabernaemontani	X	X	X1	X	6
Sparganium americanum		X		X1	16
eurycarpum		X	X	X1	8
Spartina cynosuroides		X1	X1	X1	4
Triadenum virginicum		X1	X	X	8
Typha angustifolia	X	X	X1		2
latifolia	X	X	X1		2
Xyris fimbriata		X	X1	X	7
Zizania aquatica		X			6

Notes: X indicates seed stratification technique utilized. No scarification was used on these seeds.
X1 indicates the most successful treatment observed
X2 fall (dry) seeded on raised nursery production beds

Storage Types:

Dry= cleaned seed stored in paper seed envelope

Wet= cleaned seed stored in sealed plastic bag half filled with deionized water

Wet Peat= cleaned seed mixed with equal amount of peat moss, then saturated with deionized water

Wet Sand= cleaned seed mixed with equal amount of sand then saturated with deionized water

1st Day Germ = earliest date germination was observed after stratification

BEAR CREEK FEP SITE
1996 Status Report

The Bear Creek Project is a ±100 acre parcel with a freshwater impoundment and tidal marsh which is located along the Mullica River in Atlantic County, New Jersey, near Egg Harbor City. It was donated to the New Jersey Conservation Foundation in 1986. At the time of acquisition, the predominant vegetative cover was common reed (*Phragmitis australis*), with some scattered stands of Atlantic white cedar (*Chamaecyaris thyoides*) and red maple (*Acer rubrum*). The presence of native emergent vegetation, the preferred food of most waterfowl, was limited or absent.

Since its acquisition by the NJ Conservation Foundation, efforts by a number of cooperating federal, state, and private organizations have focused on the enhancement and improvement of its critical wildlife habitat. The primary federal contributors of this project have been the U.S. Fish and Wildlife Service (FWS) and the Natural Resources Conservation Service (NRCS). State partners have included NJ Fish, Game and Wildlife, the Cape-Atlantic Soil Conservation District, and the Bureau of Forest Fire Management. In addition to the private investments of the NJ Conservation Foundation, Ducks Unlimited has matched the federal allocations to restore this wetland.

The Natural Resources Conservation Service was initially contacted for its expertise in designing and overseeing the construction of a tide gated outlet structure for the impoundment; the original outlet had failed years before. Upon completing the outlet structure, the partners collaborated on an eradication plan to control the extensive stands of common reed. The aquatic systemic herbicide, 'Rodeo', was utilized to kill the reed. Fire was utilized to eliminate any reed residue, followed by flooding to exclude this weed from re-establishing. Goals for reed control seem to have been met, but no desirable vegetative cover exists at present. Emergence of seed from acceptable species buried in the sediments is anticipated, but the potential for re-establishment by common reed still exists.

For the past five years the primary efforts at the Cape May PMC have focussed on the development of wetland plant establishment and production techniques for species native to Mid-Atlantic region. These techniques have been refined at the center, but have yet been proven on field sites. The Bear Creek Restoration site offers the high quality proving ground necessary to validate these techniques before they are recommended regionally by NRCS. Natural regeneration plots will be monitored as controls for these studies. The documentation of successfully reclaiming this sterile common reed marsh will support the development of a technical guide for the procedure. But above all, this project reveals the ability of conservation organizations to cooperate together in addressing and attaining common goals.

Five studies were established in 1996: two vegetative studies, two seeding studies, and one long term monitoring plot. Some preliminary results are available from the 1996 evaluations. There are four addition studies schedule for establishment in 1997, which will observe plant inter-actions and seed establishment.

INTER-SPECIES COMPETITION OF NATIVE WETLAND VEGETATION*

by

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* A poster paper presented at the 1996 International meeting of the Society of Ecological Restoration; Rutgers University, New Brunswick, NJ

INTRODUCTION

With the elevated involvement of NRCS in the delineation, enhancement, restoration, and creation of agriculturally associated wetlands, there exists a great need for effective plant production and establishment technologies. As many of you may already be aware, wetland ecosystems are effective at retaining storm water which implies a reduction in the threat of floods, extracting nutrients and other pollutants from surface water runoff, filtering suspended particles from runoff, as well as provide diverse wildlife habitats. The specifications and technical notes for these structures have been developed, but the plant establishment provisions are often vague or incomplete.

It became evident to the Cape May Plant Materials Center staff and its advisory committees that as NRCS takes its leading role in the agricultural wetland arena, more wetland plant establishment and management information will need to be available. In May of 1993, this PMC staff accepted the challenge to determine the needed technologies for freshwater wetland plant species of the Mid-Atlantic.

METHODS AND MATERIALS

The plants were initially acquired from commercial sources to observe the existing nursery stock available on the market. The species initially observed included: Alisma subcordatum (water plantain), Juncus effusus (soft rush), Peltandra virginica (arrow arum), Pontederia cordata (pickerel weed), Sagittaria latifolia (duck potato), Scirpus acutus (hardstem bulrush), Scirpus cyperinus (woolgrass), Scirpus tabernaemontani (soft-stem bulrush), Sparganium eurycarpum (giant burreed), Typha angustifolia (narrow-leaf cattail), Typha latifolia (broad-leaf cattail). This list, and its associated data, has since grown to include: Bidens discoidea (small beggar-tick), Carex crinita (fringed sedge), carex lurida (sallow sedge), Eleocharis obtusa (blunt spike-rush), Eriophorum virginicum (Virginia cotton-grass), Hibiscus moscheutos (swamp rosemallow), Iris versicolor (blue flag), Nuphar lutea (spatter-dock), Panicum virgatum (switchgrass), Polygonum densiflorum (dense-flower smartweed), Scirpus pungens (American threesquare), Scirpus maritimus (saltmarsh bulrush), Sparganium americanum (common burreed), Spartina cynosuroides (big cordgrass), Xyris fimbriata (fringed yellow-eyed grass), Zizania aquatica (wild rice).

All studies initiated at the Cape May PMC are performed in wetland containment cells. These impoundments have a variety of management controls; all are individually irrigated; each has specific designed hydric capabilities and soil conditions. With a variety environmental conditions various natural conditions can be tested. To compensate for the exploration of new species, in 1995 the Cape May PMC expanded its wetland study capacity with the construction of its fifth half acre wetland cell.

One aspect of wetland restoration and creation which has been paid little attention, is plant competition. Studies initiated at the Cape May PMC in 1993 were designed to observe inner and inter plant species competition. To isolate and simplify these studies only ten species were initially observed. The first study called for the random establishment of a fixed number of containerized plants in contiguous rings

around a common plot center. Keeping the same number of plants, increased inter-plant spaces as the ring diameter was expanded. In theory this study had potential for good study data, but was difficult to maintain and replicate. New designs were explored in 1994 to further study preliminary observations from the concentric ring study.

The 1994 competition studies again utilized containerized plants, but established them in more effectively designed plots (See Attached Plot Plans). Again in these studies, spacing was varied to notate plant responses to changing available growing area; species associations were also randomized for noting the growth response to species interactions. These studies have begun to yield some insight to limitations and precautions for effective establishment.

STUDY PLANS

Evaluating the Effects of Variable Spacing on Plant Growth
(1994 Wagon Wheel Planting)

Objective: to determine adequate growing space necessary for maximum fresh water emergent plant utilization, when grown in stands of single or mixed species

Location: Cape May PMC, Field #15, Cell-A

Soil: six to eight inches of sandy loam with 25% (by volume) added organics; sub-strata firmly compacted

Hydrology: firm base contains water for 4 to 5 days; shallow constructed wetland cell capable of 8 to 10 inches of inundation; water supplied from pond via irrigation pump

# of Species: twelve

Juncus effusus	Scirpus cyperinus
Peltandra virginica	Scirpus pungens
Panicum virgatum	Scirpus tabernaemontani
Pontederia cordata	Sparganium eurycarpum
Sagittaria latifolia	Typha angustifolia
Scirpus acutus	Typha latifolia

Plot Design: 16 spoke wagon wheel configuration with one species per spoke; single species radiate from a center hub

# of Replications: 2

In-Row (spoke) Plant Spacing: 1 ft.

Row Spacing: .25 - 6 ft.

Spoke or row length: 15 ft.

#/Species/Rep: 15

Evaluation:

Frequency: Monthly

Parameters:

Survival %-
Vigor-
Foliage Abundance-
Average Plant Height-
* Note Spacing at which maximum height is attained
Stem Density-
* Note Spacing at which maximum stem density is attained
Plant Damage-
Seed Yield-
Flowering Date-

Maintenance:

Inundation - May 1 through November 1 - 3 to 4 inches preferred, but at a minimum

saturated for two days is acceptable (water depths maintained with one flooding per week)
Weed Control - Hand weed as necessary
Fertilization - not necessary due to high organic level

Evaluating Inter-Plant Competition of Naturally Occurring Emergent Plant Associations
(1994 High Density Planting)

Objective: to document the growth response of fresh water emergent plant species, typically found growing naturally together, when containerized propagules are planted at six inch spacings

Location: Cape May PMC, Field #15, Cell-D

Soil: six to eight inches of sandy loam substate material without a consolidated bottom

Hydrology: shallow constructed wetland cell capable of 8 to 10 inches of inundation; water supplied from pond via irrigation pump; capable of retaining inundation for only 24 hours

# of Associations: nine

1) Juncus effusus-Peltandra virginica-Scirpus cyperinus
2) Sagittaria latifolia-Peltandra virginica-Sparganium eurycarpum
3) Juncus effusus-Typha angustifolia-Typha latifolia
4) Scirpus acutus-Scirpus cyperinus-Typha angustifolia
5) Scirpus tabernaemontani-Sparganium eurycarpum-Typha latifolia
6) Scirpus acutus-Scirpus tabernaemontani-Typha angustifolia
7) Peltandra virginica-Scirpus acutus-Typha latifolia
8) Juncus effusus-Sagittaria latifolia-Scirpus cyperinus
9) Sagittaria latifolia-Sparganium eurycarpum-Scirpus acutus

Plot Design: tightly planted square blocks of three plants of three species

# of Replications: 3 of each association

In-Row Plant Spacing: .5 ft.

Block Spacing: 3 ft.

Row length: 1 ft.

Evaluation:

Frequency: Monthly

Parameters:

Survival %-
Vigor-
Lateral Spread-
Plant Damage-
Species of Dominance-

Maintenance:

Inundation - May 1 through November 1 - soil no less than saturated (water depths maintained with two floodings per week)
Weed Control - Hand weed as necessary
Fertilization - 300 lbs./acre of 10-10-10 applied annually

RESULTS

Species with trailing rhizomes which have longer internodal spans (> 1 ft.) co-inhabit sites with no severe impacts on one another. Species with short internodal

spans and those with bunch type rooting character either do not interact or deflect rhizome encroachment.

- The survival of pickerel weed (Pontederia cordata) and arrow arum (Peltandra virginica) improves when these two species are grown with species which over top them. Over-topping grass-like species may provide protection from environmental extremes (cold, heat, wind, etc.).
- When comparing various species combinations, the trio of arrow arum, woolgrass (Scirpus cyperinus), and soft rush (Juncus effusus) is the most stable. This is probably due to their similar hydrologic requirements and reluctance to spread.
- Rhizomes of aggressive species {ie. duck potato (Sagittaria latifolia), hard-stem bulrush (Scirpus acutus), soft-stem bulrush (Sc. tabernaemontani), and cattails (Typha spp.)} easily encroach on stands of giant burreed (Sparganium eurycarpum) and three-square bulrush (Sc. pungens). But very seldom do other species extend into stands of cattails or duck potato. This behavior may imply the production of allelopathic secretions.
- When placed in close proximity on a common site, bulrush (Scirpus spp.) and cattails (Typha spp.) grow away from one another in a polarized fashion.
- In plots growing on the Cape May PMC, individual plants of most species were observed to grow at optimal rates in the presence of a diverse species composition.
- Utilizing plant spacings of < 2 feet, on ideal sites, with quality plant material, has allowed highly rhizomatous species to reach stand closure within one month after establishment. If species diversity is a primary objective, extend plant spacings; if the site needs a quick vegetative cover, reduce plant spacings to <1.5 ft.
- In the absence of competition, rhizomatous freshwater emergent plant species observed at the Cape May PMC grow uniformly in a radial fashion. The introduction of other plants, of the same or different species, within two feet changes the growth character to a rapid vector like manner.
- In dense stands of emergent vegetation, few seedlings have been observed establishing, due to shading or possibly allelopathy. In peripheral areas of the same stands, where sunlight reaches the soil surface, is where the only emerging seedlings could be found.

CONCLUSION

As the restoration of wetland ecosystems increases in frequency, the complexity of performance obstacles encountered by practitioners will become more challenging. With wetland plant studies, such as those outlined above, we have just begun to explore the community inter-relationships. The species observed in these studies have only been the most common ones native to the Mid-Atlantic region. What are the influences of the other, less common, associates on stand development and succession.

From the studies viewed in this poster, it can be concluded that both foliar and root character play a major roll in the inter-actions of species. By separating species by their root development habits, we are now able to predict compatibility and probable growth responses. In knowing the

foliar characteristics, the typical stem density of a species can be predicted. The leaf structures will impact the community's spatial development and succession. Micro-hydrology determines the dominance and composition of species of any specific site. Due to study design, it was difficult to determine if the individual mixed stand growth responses observed where stimulated by competition for sun light or soil nutrients. The site preference of each species observed at Cape May greatly influenced its ability to compete in mixed stands at various plot locations.

The Cape May PMC will continue to pursue new studies to help answer the complex questions about wetland plant interactions, while expanding the data base of a number of additional species. It is anticipated that upon completion of each study the results will be utilized as building blocks to further investigations. Continued efforts by NRCS and other cooperating organizations will be necessary over the next five to ten years in order to answer our current and developing inter-plant relationship questions.

II. PROTECT AND RESTORE COASTAL RESOURCES

1. EVALUATION OF AMERICAN BEACHGRASS (*AMMOPHILA BREVILIGULATA*) FOR LONGEVITY

2. PLANTING TRIALS FOR 'CAPE' AMERICAN BEACHGRASS (AMMOPHILA BREVILIGULATA)

3. INITIAL EVALUATION OF SEA OATS (*UNIOLA PANICULATA*)

4. SAND DUNE RESTORATION TECHNIQUES: TOPIC PAPER FROM '96 SET MEETING

5. AMERICAN BEACHGRASS GENOTYPE DISTINCTION PAPER

EVALUATION OF AMERICAN BEACHGRASS (*AMMOPHILA BREVILIGULATA*) FOR LONGEVITY

BOTANICAL DESCRIPTION (A. S. HITCHCOCK pg. 329)
Culms in tufts, commonly 70 to 100 cm. tall with deep strong extensively creeping rhizomes, the base of the culms clothed with numerous broad overlapping sheaths; ligule firm, 1 to 3 mm. long; blades elongate, firm, soon involute, curved forward past the culm, the scaberulous upper surface downward; panicle pale, 15 to 30 cm. long, nearly cylindrical; spikelets 11 to 14 mm. long; glumes scaberulous, the first 1-nerved, the second 3-nerved; lemma scabrous, the callus hairs about 2 mm. long, the rachilla about 3 mm. long.

NATIVE RANGE:
Sand dunes along the Atlantic coast from Newfoundland to North Carolina.

OBSERVATION INTEREST:
American beachgrass is the dominant foredune species from Virginia north to Nova Scotia. American beachgrass is the primary species utilized for the initial stabilization of the frontal dune along the Mid-Atlantic coast. Released from the Cape May PMC in 1972, the cultivar 'Cape' is considered to be superior for restoration use north of the Chesapeake Bay. However, many American beachgrass stands have exhibited a decline in vigor and eventual die-out on some sites despite proper management. The reasons for decline and subsequent die-off have not yet been conclusively determined.

EVALUATION OBJECTIVES:
The purpose of this study is to compare Cape to other accessions of American beachgrass to note their relative longevity and growth character. The intent of this comparison is to identify ecotypes that exhibit greater longevity while retaining the superior vigor and growth attributes associated with Cape. Additionally, attempts utilizing breeding procedures have been initiated to determine if the same objectives can be addressed with seed propagated material.

ASSEMBLY AND STATUS:
Seven (7) accessions are currently involved in the evaluation, including the cultivars Cape, 'Hatteras', and 'Bogue' as well as accessions 9047071, 9047072, 9047073, and 9047085. Hatteras, Bogue, 9047071, and 9047072 originated from the Carolinas, while 9047073 and 9047085 were collected from sites in Virginia Beach, Virginia. All seven accessions have been incorporated into our breeding program.

1996 PROGRESS UPDATE:
Seed was collected from the study crossing block, propagated and established in a replicated nursery. Accession numbers were assigned to these 1/2 sibs. Twenty individuals were selected out of this population as exhibiting morphological characteristics unique to their parental sources. These characteristics included plant height, plant width, stem density, leaf width, and foliage abundance. These 20 individuals will be harvested, divided, then outplanted into advanced evaluation plots at the PMC.

PLANTING TRIALS FOR 'CAPE' AMMOPHILA BREVILIGULATA (American beachgrass)

Annually growers, contractors and municipalities run into project limitations that require them to plant beachgrass outside the recommended dates of October 15 to April 1. These events cause the Cape May PMC to receive regular annual inquiries as to the feasibility and survivability of plantings that occur later in the spring and earlier in the summer. No data existed that would conclusively support our recommendations.

In 1994, a replicated planting trial study was implemented and concluded in 1996. Each spring two treatments were used; direct harvested materials and cold stored materials. Cold stored materials were harvested a couple weeks prior to the first planting of the spring. Beginning on or about the second week of March through late May, three replications of ten culms were planted about every two weeks for both treatments. In the fall, beginning about the last week of August and extending through the first week of November, three replications of ten culms were planted about every two weeks. However, only the direct transplanted field stock material was utilized in the fall. Data collected is contained on the following page.

Based upon these results, it is recommended that the planting dates previously determined for sand dune establishment of October 15 through April 1 remain the recommendation. But, under nursery conditions, the new recommended base planting dates will be expanded to October 15 through April 15 for direct planted and cold stored stock. Under certain circumstances, it may be necessary to plant late. When this is the case, maximum stem production can be sacrificed with good to fair survival if planting is accomplished before May 15 with cold stored material.

Planting Trials For 'Cape' American beachgrass
Ammophila breviligulata
Evaluation Data 1994-1996

94 FALL DIRECT

Planting Date:	% Sur.	Vig.	Fol. Abd.	St. Den.	Wkly Rain	Wkly Temp
8/26/94	36	2	2	97.8	0.62	77/55
9/16/94	100	2	2	80.2	1.73	79/56
9/27/94	83	4	4	77	3.62	72/54
10/10/94	100	2	2	64.2	0	62/38
10/24/94	100	2	2	66.4	0.64	66/47
11/7/94	100	2	2	69.2	0.39	67/43

95 FALL DIRECT

Planting Date:	% Sur.	Vig.	Fol. Abd.	St Den.	Wkly Rain	Wkly Temp
8/23/95	13	2	2	43.5	0	85/58
9/6/95	63	2	2	19.7	0.06	83/48
9/25/95	20	2	2	23	1.84	74/56
10/10/95	46	2	2	23.7	3.26	77/52
10/24/95	100	2	2	35.4	3.01	59/41
11/6/95	100	2	2	19.2	1.06	63/42

95 SPRING DIRECT

Planting Date:	% Sur.	Vig.	Fol. Abd.	St. Den.	Wkly Rain	Wkly Temp
3/14/95	90	2	2	68.3	0.65	59/32
3/28/95	100	2	2	55.7	0	54/36
4/12/95	95	2.8	4	60.3	0.93	58/38
4/26/95	0	0	0	0	0.65	64/44
5/15/95	35	4	6	14	1.87	74/51

96 SPRING DIRECT

Planting Date:	% Sur.	Vig.	Fol. Abd.	St Den.	Wkly Rain	Wkly Temp
3/25/96	90	1	1	40.7	0.79	51/31
4/12/96	100	2	2	23.4	1.96	56/35
4/26/96	60	3	4	28	0.38	67/46
5/7/96	90	3	5	39.3	2.37	65/46
5/24/96	33	4	7	17.6	1.21	73/51

95 SPRING COLD

Planting Date:	% Sur.	Vig.	Fol. Abd.	St. Den.	Wkly Rain	Wkly Temp
3/14/95	100	1.8	1.8	52.2	0.65	59/32
3/28/95	100	1.8	1.8	43.2	0	54/36
4/12/95	100	1.4	2	47.1	0.93	58/38
4/26/95	0	0	0	0	0.65	64/44
5/15/95	92.5	2.9	4.1	26.2	1.87	74/51
6/8/95	83.5	3	4	11.5	1.86	77/60

96 SPRING COLD

Planting Date:	% Sur.	Vig.	Fol. Abd.	St Den.	Wkly Rain	Wkly Temp
3/25/96	93	2	2	51.2	0.79	51/31
4/12/96	96	2	4	55.3	1.96	56/35
4/26/96	87	2	3	28.3	0.38	67/46
5/7/96	87	2	3	24.2	2.37	65/46
5/24/96	87	3	4	6.1	1.21	73/51

AVERAGE OF 1994 AND 1995 FALL DIRECT

Planting Range:	% Sur.	Vig.	Fol. Abd.	St. Den.
8/23/26	24.5	2	2	71
9/6/16	81.5	2	2	50
9/25/27	51.5	3	3	50
10-Oct	73	2	2	44
24-Oct	100	2	2	51
7-Nov	100	2	2	44

AVERAGE OF 1995 AND 1996 SPRING DIRECT

Planting Range:	% Sur.	Vig.	Fol. Abd.	St. Den.
3/14/95	90	2	2	68.3
3/25/28	95	1.5	1.5	48.2
4/12/12	97.5	2.4	3.5	41.9
4/26/26	60	3	4	28
7-May	62.5	3.5	5.5	53.3
24-May	33	4	7	17.6

AVERAGE OF 1995 AND 1996 SPRING COLD

Planting Range:	% Sur.	Vig.	Fol. Abd.	St. Den.
3/14/95	100	1.8	1.8	52.2
3/25/28	96.5	1.9	1.9	47.2
4/12/12	99	1.7	3	51.2
4/26/26	97	2	3	28.3
15-May	90	2.5	3.6	25.2
8-Jun	85	3	4	8.8

INITIAL EVALUATION OF SEA OATS
(UNIOLA PANICULATA)

BOTANICAL DESCRIPTION (A. S. HITCHCOCK pg. 179)
Culms stout, about 1 m. tall, from extensively creeping rhizomes; blades flat, firm, elongate, becoming involute toward the long, fine flexuous point; panicle pale, narrow, condensed, heavy and nodding, 20 to 40 cm. long, the branches arching and drooping, as much as 12 cm. long; spikelets very flat, 10-20 flowered, mostly 2 to 2.5 cm. long, 1 cm. wide, the first 4 to 6 lemmas empty, the slender pedicels shorter than the spikelets; lemmas about 9-nerved, strongly compressed-keeled about 1 cm. long, acute; palea acute, as long as the lemma, the strong wings of the keels ciliate.

NATIVE RANGE:
Sand dunes of the seacoast, Northampton County, Virginia to Florida and Texas; northern West Indies; eastern Mexico.

OBSERVATION AND INTEREST:
Sea oats is conducive to dune species diversity and is found growing in association with American beachgrass, salt meadow cordgrass, and bitter panicgrass in its native range. This material does not show susceptibility to decline vectors.

Sea oats is a warm season (C4) native, perennial bunchgrass which has potential to enhance annual net biomass production when growing with cool season American beachgrass on coastal sand dunes.

EVALUATION OBJECTIVES:
The purpose of working with sea oats is to identify or develop a strain that will:

-Grow vigorously enough to function as a companion to American beachgrass for stabilizing sand dunes.

-Exhibit cold tolerance and successful establishment in the Mid-Atlantic Region(possibly as far north as New Jersey).

-Add diversity to sand dunes to avoid mono-cultures of American beachgrass.

ASSEMBLY STATUS:
1996: Based on data collected for survival, vigor, stem density, foliage abundance, disease and insect resistance, seven accessions were selected to comprise a cultivar release. These accessions were placed in a replicated seed production block in Field 20 of the Cape May PMC. It is anticipated that a release cultivar will be completed by fall of 1997 and made available to the public.

SAND DUNE RESTORATION TECHNIQUES UTILIZED ALONG NEW JERSEY'S COASTLINE

by: Michael Fournier, Manager
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An issue paper presented at the Society of Ecological Restoration's
1996 International Conference held at Rutgers University,
New Brunswick, NJ.

June 22, 1996

INTRODUCTION

In summer, when most vacationers visit New Jersey's beaches, the Atlantic Ocean is usually a calm and passive body of water. But for those who have weathered the power of an intense hurricane or northeaster along the same coast, much respect is paid to "Mother Nature" from that day on. Such storms degrade the quality of our coastal beaches; a resource that accounts for annually contributions of $170 billion to the U.S.'s economy./1 Undisturbed coastal sand dune ecosystems are very dynamic, and heal after storms quite well. Where human disturbance and development occur much of that resilience is lost. Without adequate protection and restoration of our coastal sand dunes, the quality of the nations beaches will degrade. The resulting scenario is shocking but simple: poor dune systems = low quality beaches = decreased tourism = reduced U.S. economy ($).

In the mid 1960's the USDA Soil Conservation Service (now the Natural Resources Conservation Service) established a plant testing facility in Cape May Court House, NJ to develop vegetative solutions for erosion problems of the mid Atlantic coastal plain. Initially all efforts were focussed on addressing storm damage to sand dunes. This facility soon identified and tested a collection of American beachgrass (Ammophila breviligulata) which performed extremely well on sand dunes along the oceanfront. The selection was given the cultivar name 'Cape' after its place of origin, Cape Cod, MA. This plant cultivar has performed almost too well for nearly thirty years. Its near perfect performance and ease of establishment has escalated this plant to being literally the only species extensively planted on coastal sand dunes from Maine to North Carolina./2

Coastal communities with fixed sand dune maintenance and replenishment budgets often choose the short-term convenience of working with one species, over long-term ecologically correct approaches. In response, over the past ten years the staff at the Cape May PMC has focused on educating and encouraging the public of the advantages of diversifying the plant species of their sand dunes, rather than relying on the traditional monocultures. Economics can no longer be utilized as a viable excuse, many native sand dune species are commercially available through efforts by the Cape May Plant Materials Center.

The challenge in promoting species rich restorations and stabilizations does not hinge on quality of plant materials. It seems most communities are content with the materials and methods traditionally utilized on their sand dunes until failure strikes./3 To correct pathological outbreaks, beach front managers seek simple quick-fixes, rather than adjust planning philosophy. To assist beach front communities in becoming aware of improved techniques for protecting their sand dunes with diversification methods will be a hard up-hill struggle. This will be the case, since it is human nature to easiest follow the route of least resistance.

Methods & Materials

Over the years the staff at the Cape May PMC have attempted to promote the use of a diverse array of native species for sand dune revegetation efforts. These efforts have materialized in many forms. The following list describes most of these approaches:

- Drafting New and Improved Technical Specifications: the NRCS maintains and utilizes a Technical Field Guide which provides the design and planning procedures for recommended and proven conservation practices
- Promote Commercial Production of More Species: cultivars and techniques developed by the Plant Materials Program are increased and disseminated by commercial nurseries; providing these nurseries with a variety of species allows the consumer a choice and visual association of planting material
- Plant Release Brochures: these color Brochures are attractive and informative, leaving the reader with a good idea of the plants use, adaptability, aesthetic appeal, availability, and origin
- Annual Reports: PMC annual reports provide up dates on current studies and products, but are bulky and include all of the prior year's work summaries
- F.O. Personnel Training: NRCS's success lies in its field staff; providing periodic training to these employees equips them with the most up to date plant utilization information for providing effective solutions to erosion problems
- Information and Awareness seminars: presentations of the Cape May PMC's current activities and resource management recommendations are continually presented at local and professional meeting
- News Letter Articles: as studies are completed PMC staff often submit summaries of results, interesting discoveries, and practical information to be included in NRCS periodic news letters which are distributed to commercial nurseries, field staff, state office staff, co-operators, partnered agencies, and academia
- PMC Tours: tours of the Cape May PMC are provided to all interested parties; the audience is typically foreign and domestic dignitaries, nursery growers, agency field and advisory staff members, representatives of other agencies, and researchers
- Environmental Fair Attendance: in an attempt to interact directly with the general public, the PMC staff attends local events displaying the operation and products; written and verbal information is presented
- News Paper Articles: periodically the restoration activity of the PMC is highlighted in local newspaper coverage

Discussion

Our current culture and habits of recreational time demands easy access to the coastal beaches. As a result, individuals with the capital backing want their vacation homes as close to the surf as is legally possible. This close orientation restricts dune formation and reduces sand retention. Sand dune restoration is not as simple as establishing a native community of plants, but involves managing the sand budget (the ocean gives it and takes it away). True coastal dune restoration must consider the natural dynamics of this ecosystem. The plant species inhabiting certain niches have evolved and adapted to these locations, and require specific environmental conditions to survive establishment and persist. In recent studies by the Coastal Research Center of the University of Rhode Island, plant succession on sand dunes at Cape Cod, Massachusetts was observed to be highly dependent on mycorrhizal populations./4 In these same studies American beachgrass was noted to only thrive in those areas where sand was actively moving or accumulating, before giving ground to secondary species./4 So what happens to Am. beachgrass when it is the only species?

It is short sighted to plant only Am. beachgrass. Ammophila breviligulata is an aggressive pioneer species (4 to 6 ft. of lateral spread annually), surviving the sterile environment of newly formed sand dunes. Very few additional species can survive this harsh niche of the environment. As dunes mature and advance seaward, sand accumulation slows depriving established beachgrass their needed nutrients. Often the result is a decline in the health of plants in older stands, stimulating (fueling) the successional engine. This is the naturally occurring process. Additional light seeded native species would then typically drift into these backdune areas and become established, but houses now stand in the place where this needed seed bank once grew.

Unfortunately, the ease by which Am. beachgrass planting units establish and its effectiveness have made it difficult to persuade land owners and municipalities to consider the use of other plant species for sand dune restoration. The old adage: "if something isn't broke why fix it"; is typical of the overall attitude of beach front owners. In this case, Am. beachgrass is not perceived to be a wrong choice to completely cover the sand dunes, front to back. Over the years (30 to 40 years) it has been observed that throughout its native range Am. beachgrass is susceptible to decline after six to eight years when artificially established. The Cape May PMC has focused on the utilization of Am. beachgrass since its establishment in 1965.

'Cape' Am. beachgrass is a clonally propagated grass cultivar extensively utilized for sand dune restoration from Maine to South Carolina. It was originally developed by the Cape May PMC (publicly released in 1972) to specifically buffer and endure the erosive effects of intense coastal storms. Fortunately or unfortunately, the plant has performed beyond its expectations to protect the coastal sand dunes. In addition to its advantageous genetic traits, 'Cape' has a unique endo-phyte infection which allows it to endure attacks by

pathogens, and acquire extra amounts of water and nutrients./5 It has weathered the test of time with only isolated insect or disease outbreaks. Couple the extensive use of this single species (Ammophila breviligulata) with the utilization of a single vegetative clone of that species; then, calculate the probability of a wide scale plant failure. The results would stun the strongest advocate of exclusively utilizing Am. beachgrass for sand dunes.

With 'Cape' having no inherent mechanism currently in existence for genetic variation, the Cape May PMC staff has realized the need for a more genetically diverse beachgrass. As a first step, the PMC staff has initiated the development and/or identification of a seed produced cultivar or strain./2 Progeny from the initial crosses of tested parent stock are currently being screened for desirable characteristics. To avoid repeating hurtles from the past, all recent plant releases (1990 to present) from the Cape May PMC have planned and incorporated broad based ecotypic collections into crosses for commercial release. Multiple species are now being recommended and promoted for sand dune restorations.

Conclusion

Human nature often portrays characteristics similar to fluids, in that they tend to follow the path of least resistance. For years residents and municipalities of Mid-Atlantic coastal areas have accepted the use of Am. beachgrass as the sole protector of their expensive properties from ocean born storms. Even though results have been variable, these communities utilize the same techniques installed in prior years, and do not really accept new and often improved materials and procedures. With thirty years of test and development experience, the USDA-NRCS's Cape May Plant Material Center staff has taken a position to change the approach and attitude the public has towards protecting their valuable coastal sand dunes. It will be challenging, but through creative marketing and promotional tactics the information will be accepted.

The first step in promoting a new and improved technology must be successful demonstrations./3 Seeing is often believing for most people. The proper establishment and placement of quality demonstration plots, using multiple native species are necessary in each coastal municipality. Highly visible plantings with interpretive signs reach a large group of public beach users. Demonstrations alone will not win the confidence and support of the public administrators.

Continuing public education programs and presentations on stand dune restoration are needed to clarify and reinforce concepts initiated in demonstrations. The audience spoken to must be understood; most sand dune managers are not plant scientists or ecologists. These local and state administrator are who decide what will happen on their dunes. Helping these resource managers understand the concepts and forces of succession will assist them in grasping new ideas and approaches. The Cape May PMC staff is readily available to discuss and promote plant species diversity for the Mid-

Atlantic sand dunes with interested municipalities, consultants, nurseries, Soil Conservation Districts, environmental agencies and commissions, home owners, and engineers.

With a major portion of the nation's Gross Domestic Product being generated by beach associated travel and tourism, it is my opinion that we do not have to accept sand dune plant communities the way they have been for >25 years. With increased plant technology available to beach front managers, there is no excuse for failing to implement these improved systems and approaches. If funding for proper sand dune restoration is a limitation, maybe the deciding parties need a better understanding of the long-term costs associate with their low input alternatives.

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Hansen, S., Landau, B.J., Skaradek, W., Fournier, M., Straub, P.F. Randomly Amplified Polymorphic DNA (RAPDs) to Distinguish Genotypes of American Beachgrass (*Ammophila breviligulata*). Richard Stockton College, Natural Science & Math, Pomona, NJ 08240 (SH, BJL, PFS) and USDA, Natural Resources Conservation Service, Cape May Court House, NJ 08210 (WS, MF). UNDERGRAD, AERS

American beachgrass (*Ammophila breviligulata*) is an important sand dune stabilizing plant throughout the Atlantic coast. Increasingly, shore protection projects are incorporating beachgrass planting as an efficient, cost effective way to develop or enhance natural dune systems. Much of the planted material is the USDA 'Cape' strain developed at the Plant Materials Center along with two other selections that have been more recently released ('Bogue' and 'Hatteras'). In recent years, there have been a number of well documented cases of beachgrass die-backs and concomitant loss of erosion control. However, there is no evidence whether planted or wild material has been differentially affected by the die-outs since the grass reproduces vegetatively by a complex intertwining mat of rhizomes and roots. To address this problem, we have begun to develop a set of molecular markers to distinguish beachgrass cultivar genotypes. Seven individual cultivars developed at the USDA Plant Materials Center are being analyzed for intra-specific genetic variation using random molecular markers generated with random DNA primers and a ploymerase chain reaction(PCR). To date, we have analyzed the results of reactions with thirteen random primers and have found useful differences among five. We can presently identify six of the seven cultivars unambiguously using these primers. It is hoped that we will be able to use this information to assist in producing superior, disease resistant cultivars and to assess the levels of genetic diversity in wild dune systems that have been subjected to plantings for repair or augmentation of erosion control.

This abstract is an initial product from a recent partnership formed in 1995 between the PMC and a local college. Entering into this partnership has allowed the PMC to confirm genotypic variations in seven American beachgrass accessions. This information will support our anticipated seed propagated release.

III. CROPLAND WATER EROSION PROJECTS

1A. INITIAL EVALUATION OF EASTERN GAMAGRASS (*TRIPSACUM DACTYLOIDES*)

1B. EVALUATION OF IMPROVED EASTERN GAMAGRASS (*TRIPSACUM DACTYLOIDES*) SEEDING TECHNIQUES

INITIAL EVALUATION OF EASTERN GAMAGRASS (*TRIPSACUM DACTYLOIDES*)

BOTANICAL DESCRIPTION (A.S. Hitchcock, pg. 790)
Plants in large clumps, with thick knotty rhizomes; 2-3 m tall; glabrous throughout; blades 1-2 cm wide, flat, scabrous on margins; inflorescence 15-25 cm long, 1-3 terminal racemes, pistillate and staminate spikelets.

NATIVE RANGE: Massachusetts to Michigan, Iowa, and Nebraska, south to Florida, Oklahoma, and Texas; West Indies.

OBSERVATION AND INTEREST:
Extensive acreage within the northeast is planted to corn silage. Frequently, the crop is harvested too late to allow for the establishment of adequate winter cover, resulting in widespread soil erosion. The identification and improvement of a perennial grass with comparable nutritive value when managed for silage would be of great benefit.

Eastern gamagrass (*Tripsacum dactyloides*) is a perennial, warm-season bunch grass growing in drainage areas, streambanks, and moist places. The grass is highly productive and extremely palatable, often being greatly reduced in natural stands through preferential grazing. However, widespread use of Eastern gamagrass has been hindered by low seed production.

EVALUATION OBJECTIVE:
To select and release a cultivar of eastern gamagrass for use in the Mid-Atlantic's coastal region.

ASSEMBLY PROGRESS:
The Cape May PMC is currently evaluating 106 accessions of eastern gamagrass, 59 accessions of which represent regionally collected material (monoecious sex form or MSF) and 47 accessions which represent sexually-deviant material (gymonoecious sex form or GSF) received from the USDA/ARS Woodward, Oklahoma Experiment Station. The MSF accessions were examined with a flow cytometer at Cornell University in 1992 confirming all MSF plants examined as tetraploid.

ASSEMBLY STATUS:
The year of 1990 was considered the year of establishment. Data was collected in 1991 and 1992 which were the first and second growing season, respectively. No data was collected in 1993, 94, or 95. In 1996, data was collected on the MSF populations only. Based upon available data pertaining to plant height, inflorescence height, foliage abundance, vigor, survival, etc., each accession was given a relative ranking in respect to the top ten. These assigned ranking values are as follows:

INITIAL EVALUATION OF EASTERN GAMAGRASS (TRIPSACUM DACTYLOIDES) TOP TEN RANKED ACCESSIONS 1990-96

	MSF(Male)			GSF(Female)		
RANK	REP I	REP II	REP III	REP I	REP II	REP III
			1990 DATA			
1	9061152	9061152	9061152	9051512	9049993	9051620
2	9057803	9057808	9057803	9051611	9051603	9049993
3	9057800	9057793	9057793	9051607	9051613	9051614
4	9047807	9057806	9061210	9061210	9049980	9049980
5	9061181	9057796	9057799	9051627	9051607	9049990
6	9061210	9061210	9057807	9049980	9051610	9051612
7	9057806	9057807	9057810	9051620	9051602	9051613
8	9057811	9057811	9057800	9051613	9051627	9051607
9	9057796	9057797	9057808	9051602	9051614	9051624
10	9057810	9057809	9057806	9049997	9049977	9051610
			1991 DATA			
1	9047131	9057807	9061152	9051612	9049989	9051614
2	9057769	9057797	9057803	9051607	9051603	9051606
3	9047133	9057806	9057806	9051610	9051607	9049976
4	9047132	9057808	9057808	9051624	9049993	9050004
5	9057809	9061152	9057807	9051614	9051613	9051626
6	9057768	9061210	9057799	9049980	9051610	9051623
7	9057806	9057811	9057800	9050000	9051627	9049989
8	9057797	9057803	9061210	9051622	9051614	9050000
9	9057794	9051602	9057793	9051623	9051602	9051615
10	9057770	9049990	9057770	9049977	9049990	9051613
			1992 DATA			
1	9061152	9061152	9061152	9051620	9049980	9051620
2	9057803	9057803	9057803	9051614	9051610	9049980
3	9057809	9057809	9057809	9049977	9051611	9050000
4	9057794	9061151	9057808	9051615	9051609	9049989
5	9061210	9057806	9061210	9049989	9049993	9051625
6	9057800	9057797	9057768	9051612	9049986	9051614
7	9061239	9057807	9057799	9051610	9051612	9049993
8	9061225	9057793	9057807	9049980	9051614	9051612
9	9057770	9057810	-	9050000	9051620	9049986
10	9057795	9061210	-	9049982	9051623	9049983

	MSF(Male)
RANK	REP I-III
	1996 DATA
1	9057807
2	9051210
3	9057803
4	9057795
5	9061152
6	9057808
7	9061207
8	9047134
9	9047131
10	9057793

INITIAL EVALUATION OF EASTERN GAMAGRASS (TRIPSACUM DACTYLOIDES) TOP TEN RANKED ACCESSIONS 1990-96 (continued)

Based upon this available data, the following accessions were selected for further evaluation:

MSF(Male)	GSF(Female)
9057793	9049980
9057803	9049986
9057806	9049989
9057807	9049993
9057808	9050000
9061152	9051612
9061210	9051614
	9051620

Planting units of these accessions will be dug, processed and potted mid to late March of 97. A replicated nursery will be outplanted by mid May of 97.

EVALUATION OF IMPROVED EASTERN GAMAGRASS SEEDING TECHNIQUES (*TRIPSACUM DACTYLOIDES*)

BOTANICAL DESCRIPTION (A.S. Hitchcock, pg. 790)
Plants in large clumps, with thick knotty rhizomes; 2-3 m tall; glabrous throughout; blades 1-2 cm wide, flat, scabrous on margins; inflorescence 15-25 cm long, 1-3 terminal racemes, pistillate and staminate spikelets.

NATIVE RANGE: Massachusetts to Michigan, Iowa, and Nebraska, south to Florida, Oklahoma, and Texas; West Indies.

OBSERVATION AND INTEREST:
Extensive acreage within the northeast is annually planted to corn silage. Frequently, the crop is harvested too late to allow for the establishment of adequate winter cover, resulting in widespread soil erosion. The identification and improvement of a perennial grass with comparable nutritive value when managed for silage would be of great benefit.

Eastern gamagrass (*Tripsacum dactyloides*) is a perennial, warm-season bunch grass growing in drainage areas, along streambanks, and on both moist and dry sites. The grass is highly productive and extremely palatable, often being greatly reduced in natural stands through preferential grazing. However, widespread use of Eastern gamagrass has been hindered by low seed production. Numerous field trials attempting to establish stands of gamagrass showed poor or inconsistent performance.

EVALUATION OBJECTIVE:
The objective of this portion of the gamagrass study was to compare the establishment and forage production variations between stratified and non-stratified seed, 10 and 20 pound seeding rates, conventional tillage and no-till, 1, 2 and 3 inch seeding depths with all treatments on 32" row spacing. Data collected indicates PMC Staff efforts resulted in excellent stand establishment. Two additional years of harvest data will need to be collected before existing technical guidelines are able to be modified for the Mid-Atlantic Region.

ASSEMBLY PROGRESS AND STATUS:
Evaluation data for 1996 was compiled. Data will be collected in 1997 and this project finalized. Thus far yields are as follows:

EVALUATION OF IMPROVED EASTERN GAMAGRASS SEEDING TECHNIQUES (*TRIPSACUM DACTYLOIDES*) FORAGE CLIPPING DATA

FIRST CUTTING

Seeding Rate: 20 pounds/acre 10 pounds/acre

JUNE FORAGE CLIPPING YIELDS EXPRESSED IN TONS/ACRE

Depth	Conventional		No-Till		Conventional		No-Till	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
1"	1.60	N/A	N/A	N/A	1.70	N/A	N/A	N/A
2"	2.09	"	"	"	2.09	"	"	"
3"	2.07	"	"	"	.98	"	"	"

SECOND CUTTING

Seeding Rate: 20 pounds/acre 10 pounds/acre

AUGUST FORAGE CLIPPING YIELDS EXPRESSED IN TONS/ACRE

Depth	Conventional		No-Till		Conventional		No-Till	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
1"	.23	.49	.39	.47	.33	.36	.29	.31
2"	.46	.28	.30	.66	.39	.27	.34	.14
3"	.38	N/A	.38	N/A	.19	N/A	.29	N/A

THIRD CUTTING

Seeding Rate: 20 pounds/acre 10 pounds/acre

OCTOBER FORAGE CLIPPING YIELDS EXPRESSED IN TONS/ACRE

Depth	Conventional		No-Till		Conventional		No-Till	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
1"	.26	.36	.26	.28	.16	.08	.05	.01
2"	.80	.55	.65	.80	.19	.28	.09	.03
3"	.10	-	.20	-	.22	-	.02	-

YIELD TOTALS

Seeding Rate: 20 pounds/acre 10 pounds/acre

TOTAL FORAGE CLIPPING YIELDS EXPRESSED IN TONS/ACRE

Depth	Conventional		No-Till		Conventional		No-Till	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
1"	2.09	.85	.65	.75	2.19	.44	.34	.32
2"	3.35	.83	.95	1.46	2.67	.99	.43	.17
3"	2.55	-	.58	-	1.39	-	.31	-

YIELDS BASED ON SECOND AND THIRD CUTTINGS

FORAGE CLIPPING YIELDS EXPRESSED IN GREEN CHOP TONS/ACRE

Seeding Rate: 20 pounds/acre 10 pounds/acre

Depth	Conventional		No-Till		Conventional		No-Till	
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
1"	.49	.85	.65	.75	.49	.44	.34	.32
2"	1.26	.83	.95	1.46	.58	.99	.43	.17
3"	.48	-	.58	-	.41	-	.31	-

IV. CONTRIBUTE TO THE PRODUCTION OF PLANT MATERIAL NEEDS FOR THE NORTHEAST

1. DEVELOPMENT OF PROPAGATION TECHNIQUES FOR NATIVE PLANTS

a) Cape Cod National Seashore
b) Gateway National Recreation Area (Sandy Hook Unit)

2. CAPE MAY PMC PLANT AND SEED DISTRIBUTION

NATIONAL PARK SERVICE
CAPE COD NATIONAL SEASHORE
1996 Annual Report
prepared by
USDA NATURAL RESOURCES CONSERVATION SERVICE
CAPE MAY PLANT MATERIALS CENTER
CAPE MAY COURT HOUSE, NEW JERSEY

INTRODUCTION: Revegetation of construction impact areas, requires the use of park indigenous sources of native plant materials. The National Park Service's Cape Cod National Seashore in Massachusetts has contracted with the Natural Resources Conservation Service's Cape May Plant Materials Center in New Jersey to: collect local genotypes, propagate materials, establish increase blocks, harvest, clean, process, and store seed and vegetative materials, and coordinate timely delivery. This contract was initiated in 1994 at which point in time plant collections began. Unusual climatic conditions (cold, cloudy and wet) had considerable effect on floral abundance, pollinator activity and rate of maturation. In fact, a snowfall/frost of May 15 was a historical record. During collections, insects identified by Park personnel as the European brown tail moth, inflicted heavy crop damage on both *Prunus maritima* and *Myrica pensylvanica*. These activities coupled with multiple hurricanes and tropical storms made harvesting available material quite a challenge. Collection activities continued throughout 1996.

MATERIALS DISTRIBUTION: The delivery of quality materials began in 1996 and will continue in accordance with the contractile agreement. Materials allocated to this NPS unit for the year of 1996 included:

Common Name	Genus and Species	Seed (Lbs)	Vegetative Material
	GRASSES		
American beachgrass	*Ammophila breviligulata*		10,000
saltmeadow cordgrass	*Spartina patens*		500 plugs
	FORBS		
greenbrier	Smilax roundifolia		225 potted
seaside goldenrod	*Solidago sempervirens*		800 potted
	SHRUBS		
bayberry	*Myrica pensylvanica*	2.5 bulk	190 potted
beachplum	*Prunus maritima*	3.7 bulk	

ACCOMPLISHMENTS: In spite of fungal and insect damage, storm forced fruit shattering and abnormal fruiting dates (requiring several extra trips), adequate material of all targeted species was collected, processed cleaned and weighed. Amounts were as follows: *Gaylussacia accata* 1/2 lb., *Myrica pensylvanica* 20 lbs., *Oenothera biennis* 2.5 lbs., *Prunus maritima* 14 lbs., *Smilax* sp. 3.5 lbs., *Solidago sempervirens* 8.0 lbs.

TECHNOLOGY DEVELOPMENT: Adoption of new transplanting procedures for *Smilax* and *Myrica* resulted in over 99% survival. During the last week of May and following leaf-out, a section of the raised beds was lifted, immediately transported to a shaded plant processing room and soaked with water. To reduce transplant shock, production bed soil was used as the potting media in hopes of maintaining microbial populations, soil pH and chemistry. Once potted, materials were left in a closed building for three days and then relocated to a cold frame shaded with snow fencing.

NATIONAL PARK SERVICE
GATEWAY NATIONAL RECREATION AREA
SANDY HOOK UNIT
1996 Annual Report
prepared by

USDA NATURAL RESOURCES CONSERVATION SERVICE
CAPE MAY PLANT MATERIALS CENTER
CAPE MAY COURT HOUSE, NEW JERSEY

INTRODUCTION: In an attempt to restore the native plant resources of the Gateway National Recreation Area's Sandy Hook Unit in New Jersey, the National Park Service has contracted with the Natural Resources Conservation Service's Cape May Plant Materials Center to propagate and increase identified needed vegetation. Most of the plants and seed distributed were utilized to vegetate areas impacted by construction activity. Plant collections began in 1993 and continued through 1995. Seed increase blocks for *Panicum virgatum, Schizachyrium scoparium, Baptisia tinctoria, Chamaecrista nicitans, Oenothera biennis*, and *Solidago sempervirens* began in 1994. PMC personnel used controlled prescribed burning to enhance plant performance. One species (*Panicum virgatum*) yields were considered excellent and were documented at ±220 Lbs/Acre.

MATERIALS DISTRIBUTION: Quality materials continue to be delivered in strict accord to the contractile agreement. Materials allocated to this NPS unit for the year of 1996 included:

Common Name	Genus and Species	Seed (Lbs)	Vegetative Material
	GRASSES		
American beachgrass	*Ammophila breviligulata*		37,000
coastal panicgrass	*Panicum amarum*	14	
switchgrass	*Panicum virgatum*	28	
	FORBS		
partridge pea	Chamaecrista nicitans	3	
seaside goldenrod	*Solidago sempervirens*		4,000 plugs
	SHRUBS		
bayberry	*Myrica pensylvanica*		420 bareroot
beachplum	*Prunus maritima*		420 bareroot
dwarf sumac	*Rhus copallinum*		60 bareroot
	TREES		
eastern red cedar	*Juniperus virginiana*		100 bareroot

ACCOMPLISHMENTS AND TECHNOLOGY DEVELOPMENT: Other than those cited in previous years annual reports, no new accomplishments were experienced or expected at this late stage of the contract. Pitch pine was collected and grown for 1997 distribution.

RESTORATION OF INDIGENOUS PLANT COMMUNITIES: A USDA-NRCS / USDI-NPS PARTNERSHIP*

Michael Fournier /1

Since 1990, the USDA-Natural Resources Conservation Service's Cape May (NJ) Plant Material Center (PMC), has been providing the National Park Service's (NPS) Mid and North Atlantic Regions with indigenous plant materials for the restoration of construction disturbances at five park locations. The National Park Service's revegetation policy is to utilize only native plant materials on their properties. The plants grown at Cape May have assisted in accelerating the establishment and reclaimation of numerous indigenous plant communities on NPS property in MD, NY, NJ, and MA. Each NPS parcel has offered unique challenges to both agencies. Efforts have addressed abating old land use scars, revegetating new construction sites, improving the aesthetics of special use areas, and protecting existing public use facilities from potential storm damage. The primary funding for these restoration efforts is from a non-traditional source: gasoline taxes, allocated by the Federal Lands Highway Program. In the process of revegetating these sites, the Cape May PMC staff has successfully propagated thirty-two native species, some of which have little or no documentation of prior cultivation. A national publication, which documents propagation and production procedures for all the NPS native species explored in this nationwide program, has been published.

* Poster presented at the 1996 International meeting of the Society of Ecological Restoration, held at Rutgers University, New Brunswick, NJ.

/1 Plant Materials Center Mgr, USDA-NRCS, Cape May Court House, NJ.

1996 PLANT & SEED DISTRIBUTION
CM-PMC Cultivars

Cultivar	Species	Amount No.	Amount Lbs. (PLS)	States of Distribution
Atlantic	coastal panicgrass	3,600	190	NJ, DE, NC, MD, MO, AR, GA
Avalon	saltmeadow cordgrass	48,620		MA, DE, MO, PA, NJ, VA, GA
Bayshore	smooth cordgrass	13,000		NJ
Cape	American beachgrass	76,770		NJ, NC, MD, MO, PA WI, MA, VA, DE
Emerald Sea	shore juniper	150		MO
NJ-50	switchgrass		75	MD, VA, NJ, NY
Ocean View	beach plum	105	2 (bulk)	NJ, MA, MO
Sandy	rugosa rose	250		MO
Sea Isle	Japanese sedge	50		NJ
Va-70	shrub lespedeza		40	AR, VA
Wildwood	bayberry	319	1 (bulk)	MI, MO, NJ
TOTAL:		142,864	308	